図 005/017

PATENT

AMENDMENTS TO THE CLAIMS

Please amend the claims as indicated in the following listing of all claims:

- 1. (Currently Amended) A voltage reference generator including comprising a first bipolar transistor configured to amplify a base current of the first bipolar transistor, the base current being proportional to an absolute temperature.
- 2. (Currently Amended) The voltage reference generator, as recited in claim 1, wherein the base current is proportional to a voltage difference between two base-emitter voltages biased at different current densities, the voltage difference formed across a resistor coupled to the base of the first bipolar transistor.
- 3. (Original) The voltage reference generator, as recited in claim 1, wherein a reference voltage produced by the voltage reference generator is proportional to a parabolic function of temperature.
- 4. (Currently Amended) The voltage reference generator, as recited in claim 1, wherein the <u>first</u> bipolar transistor is a low-beta transistor.
- 5. (Original) The voltage reference generator, as recited in claim 4, wherein beta is less than ten.
- 6. (Original) The voltage reference generator, as recited in claim 4, wherein beta is less than five.
- 7. (Original) The voltage reference generator, as recited in claim 1, wherein a power supply coupled to the voltage reference generator is less than 1.7V.
- 8. (Original) The voltage reference generator, as recited in claim 7, wherein a power supply rejection ratio of the voltage reference generator is at least 60dB.

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- 9. (Original) The voltage reference generator, as recited in claim 1, wherein a reference voltage generated is less than the bandgap voltage of silicon.
- 10. (Currently Amended) An integrated circuit comprising: The voltage reference generator, as recited in claim 1, comprising:
 - a-first bipolar transistor;
 - a second bipolar transistor;
 - a resistor coupled to a base of the second <u>first</u> bipolar transistor wherein a voltage difference between a base-emitter voltage of the <u>first second</u> bipolar transistor and a base-emitter voltage of the <u>second first</u> bipolar transistor forms across the resistor; and
 - a voltage reference node receiving a voltage based at least in part on the voltage difference.
- 11. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 10, wherein a first current is based at least in part on an the amplified base current of the second first bipolar transistor, the base current being proportional to an absolute temperature.
- 12. (Currently Amended) The <u>integrated circuit voltage reference generator</u>, as recited in claim 10, wherein the second bipolar transistor operates at a current density different from the current density of the first bipolar transistor.
- 13. (Currently Amended) The <u>integrated circuit voltage reference generator</u>, as recited in claim 10, wherein the second first bipolar transistor is a low-beta transistor.
- 14. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 13, wherein beta is less than ten.
- 15. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 13, wherein beta is less than five.

- 16. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 10, further comprising:
 - a circuit coupled to the voltage reference node, the circuit generating a first voltage, the first voltage proportional to a complement of the absolute temperature.
- 17. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 10, further comprising:
 - an operational amplifier maintaining effective equivalence of a voltage on a node coupled to the first bipolar transistor and a node coupled to the second bipolar transistor.
- 18. (Currently Amended) The <u>integrated circuit voltage reference generator</u>, as recited in claim 17, wherein a noise component on the voltage reference node is substantially equivalent to noise of the operational amplifier.
- 19. (Currently Amended) The <u>integrated eireuitvoltage reference generator</u>, as recited in claim 10, wherein the integrated circuit includes a maximum of one feedback path.
- 20. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 11, further comprising:
 - a current mirror coupled to the voltage reference node, the current mirror mirroring the first current without substantially amplifying the first current.
- 21. (Currently Amended) The <u>integrated circuit voltage reference generator</u>, as recited in claim 10, wherein the voltage is proportional to a parabolic function of temperature.
- 22. (Currently Amended) The <u>integrated circuit voltage reference generator</u>, as recited in claim 21, wherein the resistor has a value adjusting an effective slope of the reference voltage as a function of temperature.
- 23. (Currently Amended) The <u>integrated circuit voltage reference generator</u>, as recited in claim 10, wherein a power supply coupled to the voltage reference node is less than 1.7V.

- 24. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 23, wherein the power supply rejection ratio is at least 60dB.
- 25. (Currently Amended) The integrated circuit voltage reference generator, as recited in claim 10, wherein the voltage is less than the bandgap voltage of silicon.
 - 26. (Original) A method for generating a reference voltage comprising: developing a base current of a first bipolar transistor, the base current being proportional to absolute temperature; amplifying the base current; and generating a reference voltage based at least in part on the amplified base current.
- 27. (Original) The method, as recited in claim 26, wherein the base current is proportional to a voltage difference between a base-emitter voltage of a second bipolar transistor and a base-emitter voltage of the first bipolar transistor, the voltage difference being formed across a first resistor coupled to a base of the first bipolar transistor.
- 28. (Original) The method, as recited in claim 26, wherein the reference voltage is proportional to a parabolic function of temperature.
 - 29. (Original) The method, as recited in claim 28, further comprising: adjusting an effective slope of the reference voltage as a function of temperature according to a first resistor.
 - 30. (Original) The method, as recited in claim 26, further comprising: maintaining substantial equivalence of a voltage on a first node and a voltage on a second node with an operational amplifier, the first and second nodes used to develop the base current.
 - 31. (Original) The method, as recited in claim 26, further comprising: mirroring the amplified current, the mirroring having an effective gain of one.

- 32. (Original) The method, as recited in claim 27, wherein the first bipolar transistor is a low-beta transistor.
 - 33. (Original) The method, as recited in claim 32, wherein beta is less than ten.
 - 34. (Original) The method, as recited in claim 32, wherein beta is less than five.
- 35. (Original) The method, as recited in claim 26, wherein the reference voltage is less than the bandgap voltage of silicon.
- 36. (Currently amended) The method, as recited in claim 26, wherein a power supply coupled to the voltage reference node is less than 1.7V.
- 37. (Original) The method, as recited in claim 36, wherein the power supply rejection ratio is at least 60dB.
- 38. (Original) A computer readable medium encoding an integrated circuit product comprising:
 - a first bipolar transistor;
 - a second bipolar transistor;
 - a resistor coupled to a base of the second bipolar transistor wherein a voltage difference between a base-emitter voltage of the first bipolar transistor and a base-emitter voltage of the second bipolar transistor forms across the resistor; and a voltage reference node receiving a voltage based at least in part on the voltage difference.
- 39. (Original) The computer readable medium encoding an integrated circuit product, as recited in claim 38, wherein a first current is based at least in part on an amplified base current of the second bipolar transistor, the base current being proportional to an absolute temperature.
 - 40. (Original) A method of manufacturing an integrated circuit comprising: forming a first bipolar transistor;

forming a second bipolar transistor;

- forming a resistor coupled to a base of the second bipolar transistor wherein a voltage difference between a base-emitter voltage of the first bipolar transistor and a base-emitter voltage of the second bipolar transistor forms across the resistor; and forming a voltage reference node receiving a voltage based at least in part on the voltage difference.
- 41. (Original) The method, as recited in claim 40, further comprising:
- a first current is based at least in part on an amplified base current of the second bipolar transistor, the base current being proportional an absolute temperature.
- 42. (Original) The method, as recited in claim 40, wherein the second bipolar transistor operates at a current density different from the current density of the first bipolar transistor.
- 43. (Original) The method, as recited in claim 40, wherein the first bipolar transistor is a low-beta transistor.
 - 44. (Original) The method, as recited in claim 40, wherein beta is less than ten.
 - 45. (Original) The method, as recited in claim 40, wherein beta is less than five.
 - 46. (Original) The method, as recited in claim 40, further comprising: forming a circuit coupled to the voltage reference node, the circuit generating a first voltage, the first voltage proportional to a complement of the absolute temperature.
 - 47. (Original) The method, as recited in claim 40, further comprising:
 - forming an operational amplifier maintaining effective equivalence of a voltage on a node coupled to the first bipolar transistor and a node coupled to the second bipolar transistor.

- 48. (Original) The method, as recited in claim 47, wherein a noise component on the voltage reference node is substantially equivalent to noise of the operational amplifier.
 - 49. (Original) The method, as recited in claim 41, further comprising: forming a current mirror coupled to the voltage reference node, the current mirror mirroring the first current without substantially amplifying the first current.
- 50. (Original) The method, as recited in claim 40, wherein the voltage is proportional to a parabolic function of temperature.
- 51. (Original) The method, as recited in claim 50, wherein the resistor has a value adjusting an effective slope of the reference voltage as a function of temperature.
- 52. (Original) The method, as recited in claim 40, wherein a power supply coupled to the voltage reference node is less than 1.7V.
- 53. (Original) The method, as recited in claim 52 wherein the power supply rejection ratio is at least 60dB.
- 54. (Original) The method, as recited in claim 40, wherein the voltage is less than the bandgap voltage of silicon.
 - 55. (Original) An apparatus comprising:
 - means for developing a base current of a bipolar transistor, the base current being proportional to absolute temperature;
 - means for amplifying the base current; and
 - means for generating a reference voltage based at least in part on the amplified base current.
- 56. (Original) The apparatus, as recited in claim 55, wherein the voltage varies according to a parabolic function of temperature.

57. (Original) The method, as recited in claim 55, further comprising: means for adjusting an effective slope of the reference voltage as a function of temperature.